

**ROCKY FLATS PLANT
EMD OPERATING
PROCEDURES MANUAL
VOLUME III: GEOTECHNICAL**

**Manual No.: 5-21000-OPS-GT
Procedure No.: Table of Contents, Rev 60
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**THIS IS ONE VOLUME OF A SIX VOLUME SET
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VOLUME III: GEOTECHNICAL (GT)
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ADMINISTRATIVE

**DOCUMENT CLASSIFICATION REVIEW WAIVER
PER R.B. HOFFMAN, CLASSIFICATION OFFICE
JUNE 11, 1991**

A-SW-001372

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DCN 93.02	5.5 Time Domain Electromagnetic Metal Detection	2	11/22/93
GT.19	Field Gas Chromatographs	2	05/12/92
GT.20	Procedures for Soil Interstitial Water Sampling and Sampler Installation	2	05/12/92
94-DMR-000297	Section GT.20 and form Modifications	2	02/28/94
GT.21	Cone Penetrometer Testing	1	05/12/92
GT.24	Approval Process for Construction Activities on or Near Individual Hazardous Substance Sites (IHSSs)	0	05/12/92

DOCUMENT MODIFICATION REQUEST (DMR)

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SCRA 42174

Refer to 1-A01-PPG-001 for Processing Instructions.

Print or Type All Information (Except Signatures)

1. Date 04/20/94			25. DMR No. 94-DMR-000801		
2. Existing Document Number/Revision 5-21000-OPS-GT.6, Rev. 2			3. New Document Number or Document Number if it is to be changed with this Revision NA		
4. Originator's Name/Phone/Page/Location J.A. Paschis/X8644/NA/080-645			5. Document Title Monitoring Well and Piezometer Installation		
6. Document Type <input checked="" type="checkbox"/> Procedure <input type="checkbox"/> Other		7. Document Modification Type (Check only one) <input type="checkbox"/> New <input type="checkbox"/> Revision <input checked="" type="checkbox"/> Intent Change <input type="checkbox"/> Nonintent Change <input type="checkbox"/> Editorial Correction <input type="checkbox"/> Cancellation			
8. Item	9. Page	10. Step	11. Proposed Modifications		
1	2	2.0	This procedure has 9 active DMRs/DCNs against it, and is currently being revised. However, in order to continue operations, this DMR is being issued in parallel with the revision.		
			Replace first paragraph with the following paragraph: This standard operating procedure (SOP) describes requirements for administrative documentation of new monitoring wells (and piezometers) and field procedures that will be used for installing monitoring wells and piezometers (open-pipe) at Rocky Flats Plant (RFP). This SOP contains the forms for documentation and describes the equipment for drilling, field procedures, well material specifications, and decontamination procedures that will be used to install monitoring wells and open-pipe piezometers in order to attain acceptable standards of accuracy, precision, comparability, representativeness, and completeness.		
2	3	4.1	Add the following reference: <u>Revised and Amended Rules and Regulations of the Board of Examiners of Water Well Construction and Pump Installation Contractors, 2CCR 402-2. State of Colorado, Office of the State Engineer, Denver, Colorado, Revised Effective August 1, 1988.</u>		
12. Justification (Reason for Modification, EJO#, TP#, etc.)					
1. Informs well requestor that information about new well installation is needed for well permitting to the Office of the State Engineer.					
2. New reference cites CO regulatory statutes relative to well installation.					
If modification is for a new procedure or a revision, list concurring disciplines in Block 13, and enter N/A in Blocks 14 and 15. If modification is for any type of change or a cancellation, organizations are listed in Block 13, then Concuror prints, and signs in Block 14, and dates in Block 15.					
13. Organization	14. Print and Sign (if applicable)				15. Date (if applicable)
SME	R.G. Smith <i>R.G. Smith</i>				4/20/94
EQS	M.C. Brooks (SR) <i>M.C. Brooks</i>				5/17/94
RPM	W.S. Busby <i>W.S. Busby</i>				5/15/94
SPP	S.R. Keith <i>S.R. Keith</i>				5/16/94
EOM	M.C. Broussard <i>M.C. Broussard</i>				5/2/94
16. Originator's Supervisor (print/sign/date) Stephen H. Singer <i>Stephen H. Singer</i> 4/20/94					
17. Assigned SME/Phone/Page/Location R.G. Smith/X8705/D5135/080-643		18. Cost Center 0202		19. Charge Number ENV-GT	20. Requested Completion Date 04/29/94
22. Accelerated Review? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		23. ORC Review ORC Review not required; this nonintent change was processed as an intent change to expedite the DMR process.			
24. Responsible Manager (print, sign, date) Mark E. Levin <i>Mark E. Levin</i> 4/20/94					

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BY NA
DATE NADOCUMENT CLASSIFICATION REVIEW WAIVER
PER R.B. HOFFMAN, CLASSIFICATION OFFICE
JUNE 11, 1991

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DMR No. 94-DMR-000801

2. or 3. Document Number/Revision

5-21000-OPS-GT.6/2

3. Document Title

Monitoring Well and Piezometer Installation

8. Item	9. Page	10. Step	11. Proposed Modifications
3	3	4.2	<p>Add the following references:</p> <ul style="list-style-type: none"> • SOP FO.14, Field Data Management • SOP GT.24, Approval Process for Construction Activities on or Near Individual Hazardous Substance Sites (IHSSs)
4	3	5.0 & 5.1 (new)	<p>Insert the following new Sections 5.0 and 5.1, and consecutively renumber the old Sections 5.0 and 6.0 to 6.0 and 7.0, respectively .</p> <p>5.0 ADMINISTRATIVE DOCUMENTATION PRECEDING WELL INSTALLATION</p> <p>The Well Installation Notification (WIN), Form GT.6B is to be completed to ensure that new well administrative controls are met by the inclusion of requestor information, installation methods, purpose, initial well permit data, environmental protection measures, and additional information.</p> <p>The requestor should supply information necessary for the Environmental Science and Engineering, Geosciences Division to prepare and file applicable well permits required by the state of Colorado. The information will be used in applying for the: 1) <i>Notice of Intent to Construct</i>: well owner's notice to drill a well. (This must be submitted to the Division of Water Resources three days prior to invasive activities.); and, 2) <i>Permit to Construct a Well</i>: application form issued and approved by Division of Water Resources permitting construction for purposes such as groundwater monitoring, production, or recovery. (Additional permits are required for the installation of a pump). An approved soil disturbance permit is also required by RFP Construction Management. These pre-drilling administrative procedures will be coordinated through the Geosciences Division.</p> <p>5.1 INSTRUCTIONS FOR ADMINISTRATIVE DOCUMENTATION</p> <p>After Work Plan approval, administrative tracking for new wells (and piezometers) requires the following steps be implemented as an essential part of the planning stage prior to well installation. These procedures are for the purpose of assigning location codes (well numbers), initiating well construction permits required by the Division of Water Resources, and acquiring soil disturbance permits.</p> <p>5.1.1 Submit one Well Installation Notification (WIN), Form GT.6A for each new well or piezometer to Geosciences Division for approval.</p> <p>5.1.2 Receive approved WIN form and copy of approved Notice of Intent to Construct.</p> <p>5.1.3 Submit WIN form and apply for Soil Disturbance Permit to RFP Construction Management.</p> <p>5.1.4 Receive approved Soil Disturbance Permit.</p> <p>5.1.5 Receive notice from Geosciences Division that well permits have been approved by Division of Water Resources and well installation may proceed.</p>

2. Justification (Reason for Modification, EJO#, TP#, etc.)

3. Internal references cite additional guidance procedures used for pre-installation of wells and data management.

4. Specific data requested is to complete information for well permitting to Office of the State Engineer and for well requestor to receive unique location code for well control; provides well requestor with procedural instructions applicable to well permit acquisition.

Refer to 1-A01-PPG-001 for Processing Instructions.
Print or Type All Information (Except Signatures)

25.

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2. or 3. Document Number/Revision 5-21000-OPS-GT.6/2			3. Document Title Monitoring Well and Piezometer Installation	
8. Item	9. Page	10. Step	11. Proposed Modifications	
4 cont.			<p>5.1.6 Following well installation, submit copies of Groundwater Monitoring Well and Piezometer Report, form GT.6B, Well Development form GW.2A, land survey coordinates and RFP Borehole Log form GT.1A to Geosciences Division as soon as possible.</p> <p>5.1.7 If applicable, provide Geosciences Division supplemental information for end-use requirements of well to obtain additional well/pump permits.</p>	
5	16	7.0	<p>Insert following as new 1st paragraph in front of existing 1st paragraph:</p> <p>7.0 DOCUMENTATION</p> <p>Provide the WIN form to the Geosciences Division as instructed in 5.1.1. Submit copies of applicable (Sections 5.1.6, and 8.0) records related to this administrative procedure to Geosciences Division.</p>	
6	17	8.0	<p>Replace Form GT.6A, Groundwater Monitoring Well and Piezometer Report Form with Form GT.6B.</p>	
7	18	8.0	<p>Add the following section to end of text, page 18, GT.6.</p> <p>8.0 ADMINISTRATIVE DOCUMENTATION</p> <p>The two forms for documenting well completion data and well installation notification for wells (and piezometers) follow this section. The Well Installation Notification form GT.6A is completed and submitted to the Geosciences Division. Field information documented on the Groundwater Monitoring Well and Piezometer Report form GT.6B should be entered in electronic data format as specified in SOP FO.14 Field Data Management form FO.14G. Upon completion of data entry and quality control check, Form GT.6B is delivered to the Operable Unit Project Manager.</p>	
12. Justification (Reason for Modification, EJO#, TP#, etc.)				
<p>5. Informs well requestor of type and filing location of documents.</p> <p>6. Replaces old form with new form required for RFEDS update.</p> <p>7. Provides well requestor/installer guidance on the filing of completed forms.</p>				

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Category 2

TITLE:
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Approved By:

/s/ J.E. Evered
(Name of Approver)

05/12/92
(Date)

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2.0 PURPOSE AND SCOPE

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This standard operating procedure (SOP) describes requirements for administrative documentation of new monitoring wells (and piezometers) and field procedures that will be used for installing monitoring wells and piezometers (open-pipe) at the Rocky Flats Plant (RFP). This SOP contains the forms for documentation and describes the equipment for drilling, field procedures, well material specifications, and decontamination procedures that will be used to install monitoring wells and open-pipe piezometers in order to attain acceptable standards of accuracy, precision, comparability, representativeness, and completeness.

3.0 PERSONNEL QUALIFICATIONS

Personnel overseeing the installation of monitoring wells and piezometers will be geologists, geotechnical engineers, or field technicians with an appropriate amount of applicable field experience or on-the-job training under the supervision of another qualified person.

4.0 REFERENCES

4.1 SOURCE REFERENCES

The following is a list of references reviewed prior to the writing of this procedure:

A Compendium of Superfund Field Operations Methods. EPA/540/P-87/001. December 1987.

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. EPA/540/G-89/004 October 1988.

RCRA Facility Investigation Guidance. Interim Final. May 1989.

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RCRA Groundwater Monitoring Technical Enforcement Guidance Document. EPA, OSWER-9950.1, Washington D.C., September 1986.

Revised and Amended Rules and Regulations of the Board of Examiners of Water Well Construction and Pump Installation Contractors, 2CCR 402-2. State of Colorado, Office of the State Engineer, Denver, Colorado, Revised Effective August 1, 1988.

4.2 INTERNAL REFERENCES

Related SOPs cross-referenced by this SOP are as follows:

- SOP FO.3, General Equipment Decontamination
- SOP FO.4, Heavy Equipment Decontamination
- SOP FO.8, Handling of Drilling Fluids and Cuttings
- SOP FO.14, Field Data Management
- SOP FO.15, Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs)
- SOP FO.16, Field Radiological Measurements
- SOP GT.1, Logging Alluvial and Bedrock Material
- SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques
- SOP GT.3, Isolating Bedrock from the Alluvium with Grouted Surface Casing
- SOP GT.4, Rotary Drilling and Rock Coring
- SOP GT.24, Approval Process for Construction Activities on or Near Individual Hazardous Substance Sites (IHSSs)

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5.0 ADMINISTRATIVE DOCUMENTATION PRECEDING WELL INSTALLATION

The Well Installation Notification (WIN), Form GT.6A is to be completed to ensure that new well administrative controls are met by the inclusion of requestor information, installation methods, purpose, initial well permit data, environmental protection measures, and additional information.

The requestor should supply information necessary for Environmental Science and Engineering, Geosciences Division to prepare and file applicable well permits required by the state of Colorado. The information will be used in applying for the: 1) *Notice of Intent to Construct*: well owner's notice to drill a well. (This must be submitted to the Division of Water Resources three days prior to invasive activities.); and 2) *Permit to Construct a Well*: application form issued and approved by Division of Water Resources permitting construction for purposes such as groundwater monitoring, production, or recovery. (Additional permits are required for the installation of a pump.) An approved soil disturbance permit is also required by RFP Construction Management. These pre-drilling administrative procedures will be coordinated through the Geosciences Division.

5.1 INSTRUCTIONS FOR ADMINISTRATIVE DOCUMENTATION

After Work Plan approval, administrative tracking for new wells (and piezometers) requires the following steps be implemented as an essential part of the planning stage prior to well installation. These procedures are for the purpose of assigning locaiton codes (well numbers), initiating well construction permits required by the Division of Water Resources, and acquiring soil disturbance permits.

5.1.1 Submit one Well Installation Notification (WIN), Form GT.6A for each new well and piezometer to Geosciences Division for approval.

5.1.2 Receive approved WIN form and copy of approved Notice of Intent to Construct.

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5.1.3 Submit WIN form and apply for Soil Disturbance Permit to RFP Construction Management.

5.1.4 Receive approved Soil Disturbance Permit.

5.1.5 Receive notice from Geosciences Division that well permits have been approved by Division of Water Resources and well installation may proceed.

6.0 EQUIPMENT AND PROCEDURES FOR MONITORING WELL AND PIEZOMETER INSTALLATION

Groundwater monitoring wells and open-pipe piezometers (observation wells) will be constructed in boreholes drilled and logged according to SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques, or SOP GT.4, Rotary Drilling and Rock Coring, and SOP GT.1, Logging Alluvial and Bedrock Material. The construction of monitoring wells is the same as that used for piezometers. The distinction between wells and piezometers is based on the intended use. Wells are used for obtaining samples of groundwater while piezometers are intended only for water level measurements. If different types of piezometers are required (e.g., isolated electronic or pneumatic piezometers), they will be addressed in another SOP or in a project-specific work plan. All drilling

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and sampling equipment and materials will be protected from the ground surface with clear plastic sheeting or will be placed on clean drill racks.

Personnel installing monitoring wells need to be cognizant of the many factors influencing the screened intervals selected for wells. For example, water table wells should have screens of sufficient length at the appropriate depth to monitor the water table. Wells with slow recharge should have sufficient screen area to allow adequate sample volume. However, long screened intervals should generally be avoided since they are of limited value for characterizing discrete zones of contamination.

Selection of well screen intervals may also depend on the suspected presence of light or dense immiscible layers of contaminants floating on the water table or residing at the bottom of a hydrostratigraphic unit (HSU). Screened intervals across different HSUs should generally be avoided particularly where there is a potential for cross-contamination between HSUs to occur.

These factors must be addressed during project planning, and the Field Sampling Plan (FSP) will normally provide rationale for the planned sampling. Personnel installing monitoring wells should be familiar with the FSP and the rationale used in determining well screen intervals.

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6.1

EQUIPMENT AND MATERIALS

The following is a list of equipment and well materials for well installation:

- Drill rig with appropriately-sized drill bits, augers, and/or rods
- High pressure steamer/sprayer
- Sand bailer
- Long-handled bristle brushes
- Wash/rinse tubs

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- Phosphate-free, lab-grade detergent (e.g., Liquinox)
- Weighted tape measure
- Water level probe
- Distilled water
- Drums for containment of cuttings
- Appropriate health and safety equipment
- Field book
- Location map
- Boring log form
- Groundwater observation well report

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6.2

DRILLING PROCEDURES

Boreholes for wells will be drilled by using a drill rig and drilling method capable of completing the well to the depth specified in the FSP. All drilling equipment, including the drill rig, water tanks; and all downhole equipment will be decontaminated according to SOP FO.3, General Equipment Decontamination and SOP FO.4, Heavy Equipment Decontamination. Downhole equipment will be decontaminated between boreholes, and other equipment such as the drill rig will be decontaminated between different work areas.

Before drilling, test borings/wells will have been located, numbered, and identified by using stakes or paint sticks on paved surfaces. Drilling locations will be cleared for buried metal objects and utility interference according to SOP GT.10, Borehole Clearing. Boreholes will be advanced from the ground surface to a predetermined target depth given in the FSP. Boreholes drilled for wells will be logged stratigraphically by examination of the sample cuttings or core samples according to SOP GT.1, Logging Alluvial and Bedrock Material.

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If hollow-stem augers are used for alluvial wells, the boreholes will be augured as little as possible into claystone bedrock (approximately one foot or less), since the claystone bedrock cuttings may tend to be smeared along the side of the borehole in the alluvium. Therefore, after the augers have been advanced to the bedrock contact, an appropriately-sized drive sampler will be driven 2 feet into the claystone bedrock to provide a pilot hole, no more than 1 inch greater than the outside diameter (O.D.) of the casing, for a 2-foot deep sediment sump. Where claystone smearing is not a problem, auger 2 feet into bedrock to provide a pilot hole for a 2-foot deep sediment sump. The sediment sump will be a 2-foot-long piece of blank casing installed immediately beneath the screen in all wells.

If a center bit is used instead of a continuous hollow-stem core sampler, a drive sample may be taken after the interval is drilled to ascertain if the alluvial/bedrock contact has been reached. After a maximum of a 1-foot drive sample, coring will resume if indicated. During the drilling process, the center bit will be removed slowly to prevent sand from entering (blowing into) the bottom auger. In the event of sand blow-in, RFP potable water may be added to the inside of the augers to equalize the hydrostatic pressure of the formation water. A record of the intervals drilled using a center bit and/or the amount of water placed in the well will be noted on the applicable log sheets. The amount of water placed in the well (if applicable) will be recorded so that it can be taken into account during well development.

The inside diameter (I.D.) of the augers will be approximately 4 inches or more larger than the O.D. of the casing, resulting in a 2-inch annulus around the casing. Similarly, a 2-inch annulus will be provided around well screens and casings when wells are constructed in open portions of boreholes. In open-hole installation (wells constructed in uncased boreholes), the use of stainless steel casing centralizers will be required to ensure the 2-inch annulus is maintained. Centralizers should be provided above and below the well screen, but not within the bentonite seal. Depending on the well depth and diameter, centralizers may also be required at intervals along the riser to provide a 2-inch grout annulus. When hollow-stem augers are used, centralizers will only be

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required if the auger flights are not a sufficient size to ensure a 2-inch minimum annulus dimension on all sides of the screen.

During the drilling operation, the cuttings and formation water from the boring will be placed in environmental materials drums if required (see SOP FO.8, Handling of Drilling Fluids and Cuttings).

Single-cased wells will be used in the alluvial/unconfined aquifer. Double casing may be required for bedrock wells installed in areas of potentially contaminated alluvial groundwater. If required, surface casing will be installed through the alluvium according to SOP GT.3, Isolating Bedrock from the Alluvium with Grouted Surface Casing.

Boreholes for alluvial and bedrock wells will be drilled according to SOP GT.2, Drilling and Sampling Using Hollow-Stem Auger Techniques or SOP GT.4, Rotary Drilling and Rock Coring.

6.3 WELL MATERIALS AND INSTALLATION PROCEDURES

6.3.1 Materials

6.3.1.1 Well Casings

Well casings will consist of new, threaded, flush-joint schedule 40 or schedule 80 poly-vinyl chloride (PVC) unless another type of casing (e.g., stainless steel) is required by the FSP or project-specific work plan. The well casing will extend from the top of the well screen to approximately 2 feet above ground surface. The tops of all well casings will be fitted with slip-on or threaded PVC caps which can be easily removed by hand. All joints within the casing string will be threaded. Heat-welded joints, solvents, and/or gaskets will not be used. According to the manufacturer's recommendations, O-rings will be used between joints or Polytetra fluoroethylene (PTFE) tape will be wrapped around

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94-DML-000801 | the joint threads to improve the seal. All well casings will be free of foreign material and will be steam cleaned with approved water before use. Steam-cleaned casings will be stored in plastic sleeves prior to use. Casing with stamped or stenciled nomenclature will not be used.

94-DML-000801 | 6.3.12 Well Screens

Well screens will consist of new threaded PVC pipe (unless another material [e.g., stainless steel] is required by the FSP or a project-specific work plan) with 0.010-inch factory-machined slots or wrapped screen. All well screens will have an I.D. equal to or greater than that of the well casing. The wall thickness of PVC screen will be the same as that of the well casing. A 2-foot deep sediment sump will be used beneath the screen. A threaded cap or a slip-on cap secured with stainless steel screws will be provided at the bottom of the sump. Well screen with stamped or stenciled nomenclature will not be used.

94-DML-000801 | 6.3.13 Filter Pack

The filter pack material will be chemically inert, rounded, silica sand of appropriate size for the well screen and host environment. Grain size analyses of the unconsolidated formations underlying the site have indicated a 16-40 gradation is appropriate, and it will be used on the site unless the FSP or project-specific work plan indicates otherwise. The filter pack will extend approximately 2 feet above the top of the screen unless otherwise specified. Where the thickness of the alluvium is insufficient, the top of the filter pack may extend 6 inches above the top of the screen. The final depth to the top of the filter pack will be measured directly by using a weighted tape measure and not by using volumetric calculation methods. The volume placed will be recorded.

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6.3.1.4 Bentonite Seal

A bentonite seal will be installed above the filter pack. The seal will consist of a layer of commercially available bentonite pellets that is at least 3 feet thick when measured immediately after placement, without allowance for swelling.

6.3.1.5 Bentonite Grout

The annular space between the well casing and the borehole will be grouted from the top of the bentonite seal to ground surface. The grout will consist of high-solids reduced pH bentonite grout (American Collöid Pure Gold or approved equivalent) mixed in a powered mechanical grout mixer according to the grout manufacturer's recommendations. The grout may be mixed by hand for intervals less than 5 feet thick. The grout will contain at least 30 percent solids by weight and have a minimum density of 9.9 pounds per gallon after mixing. The density will be checked with a mud balance.

Grout will be placed outside of the monitoring well casing using a side-discharge tremie pipe located just above the top of the bentonite seal. The grout will be pumped through the pipe until undiluted grout flows from the annular space at the ground surface. The tremie pipe will then be removed and more grout added to compensate for settling. After 24 hours, the site will be checked for grout settlement and more grout added to fill any depressions. The total volume placed will be recorded.

When excessive grout loss into landfilled materials occurs, grouting will be stopped and bentonite chips or pellets will be added to the annular space to seal off the area losing grout. A minimum of two feet of pellets or chips will be added, then grouting will resume as above. If grout loss continues or if grout is again lost further uphole, grouting will again be stopped and additional bentonite pellets or chips will be added until grout loss is stopped.

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6.3.2 Installation Procedures

6.3.2.1 Alluvial Piezometer and Monitoring Well Installation

Figure GT.6-1 shows a schematic diagram of the lower portion of an alluvial well completion. Monitoring well installation will begin after formation water and fine grained sediment have been bailed using a sand bailer until the water is relatively clear and free of sediments. If granular soils do not blow into the bottom auger, raising the augers 1 to 2 feet above the bottom of the hole can help with the removal of muddy water from outside of the augers. This will not work if the hole bottom caves or blows in.

The borehole depth and the well assembly will be measured to the nearest 0.1 foot. The portion of the well casing cut off at the top will be measured and subtracted from the total length supplied to determine the total well assembly length. Before placing the well assembly into the borehole, any void space between the bottom of the borehole and the bottom of the sediment sump will be backfilled with commercially available bentonite pellets.

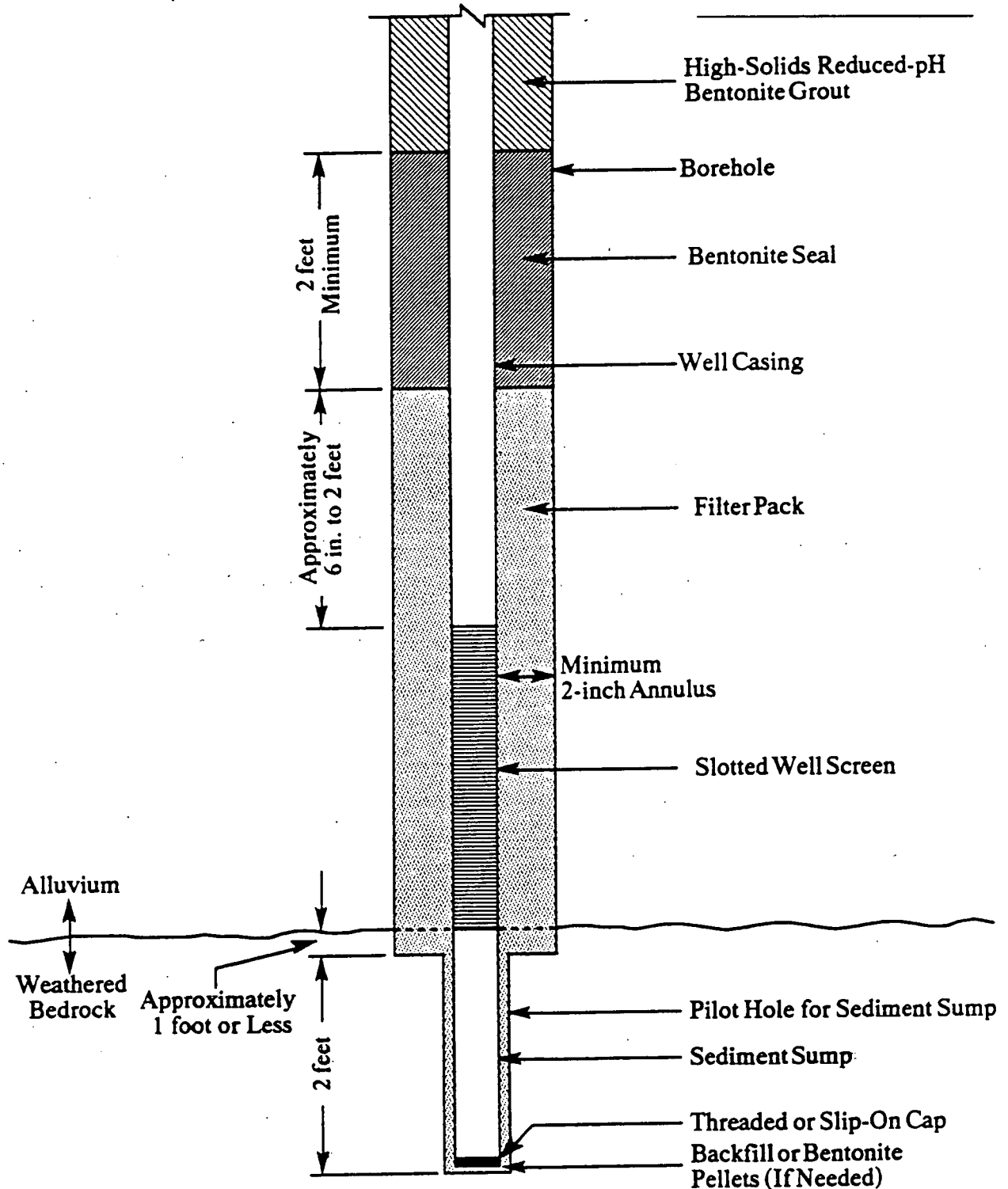
Once the well assembly is in place, the filter pack will be added slowly to the zone below the water level in the borehole by tremie pipe. If filter pack material is placed in wells above the water level in the borehole, a tremie pipe will not be required inside of hollow-stem augers. A tremie pipe will be required for all filter placement in open hole completions. The filter pack will be added in 1- to 2-foot increments. Similarly, the augers will be raised in 1- to 2-foot increments so that the sand level is always at or slightly above the bottom of the augers. Depth measurements of the top of the filter material will be taken continuously in the well annulus as the filter is placed. The final depth to the top of the filter pack will be approximately 2 feet, but in no case less than 6 inches, above the top of the well screen. The top of the filter pack will be directly measured by a weighted tape measure. The weight on the tape measure will be stainless steel in the event that it accidentally becomes embedded in the filter pack. If bridging of the filter material occurs in the well annulus

FIGURE GT.6-1 SCHEMATIC DIAGRAM OF ALLUVIAL MONITORING WELL COMPLETION

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NOTE: This figure illustrates guidelines for alluvial wells to show maximum bedrock penetration.

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Not To Scale

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or tremie pipe during placement, the bridged material will be broken loose mechanically by shaking the augers and/or well assembly. Bridged material in the annulus may also be broken loose by probing with a 1-inch-diameter tremie pipe. If both of these methods are unsuccessful, distilled water may be pumped through the 1-inch tremie pipe to dislodge the bridged material. A record of the amount of water placed in the well will be kept so that it can be taken into account during well development. The volume of filter material placed will also be recorded.

A minimum 2-foot bentonite pellet seal (before swelling) will be installed immediately above the filter pack. If the bentonite pellet seal will be placed below the water table, it will be installed through a tremie pipe. The bentonite pellets will be added slowly to reduce the chances for bridging of the pellets inside the tremie. The augers will be raised approximately 1 foot above the filter pack prior to adding the bentonite pellets. The top of the bentonite seal should never be above the base of the augers. If the bentonite seal is placed above the water level in the borehole, the pellets may be allowed to free-fall into the borehole if hollow-stem augers are being used. The bentonite will be hydrated using 5 gallons of distilled water after the base of the augers are raised approximately 1 foot above the top of the bentonite seal. The completed bentonite seal will be allowed to hydrate for approximately 30 minutes before proceeding with the grouting operation.

Bentonite grout backfill will be placed from the top of the bentonite seal to the ground surface. The grout mixture will conform to the specifications outlined in Subsection 5.3.1.5, Bentonite Grout. The grout will be tremied into the well annulus using a side-discharge tremie until it is completely full. The volume of grout placed will be recorded. The well casing will be checked for plumb by use of a weighted tape measure lowered from the center of the casing. If the tape measure touches the side of the casing prior to reaching the bottom, the casing will be shifted as much as possible to a vertical alignment and held in place while the grout sets up and hardens. After settlement of the bentonite grout has been allowed for 24 to 72 hours, the protective steel casing will be embedded in cement-bentonite grout or nonshrink concrete. The cement-containing grout will occupy the upper 1 1/2 to 3 feet of the well annulus to anchor the protective casing. This may

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require removing some of the bentonite grout from the upper 1 1/2 to 3 feet of the well annulus. If the upper grout surface is dehydrated, it will either be removed or rehydrated by adding water and waiting approximately 30 minutes. When alluvial wells are installed in areas with minimal alluvial thicknesses and the bentonite seal is within 1.5 to 3 feet of the surface, no bentonite grout is needed, and the protective steel casing can be embedded in the required cement-bentonite grout.

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6.3.2.2 Bedrock Piezometer and Monitoring Well Installation

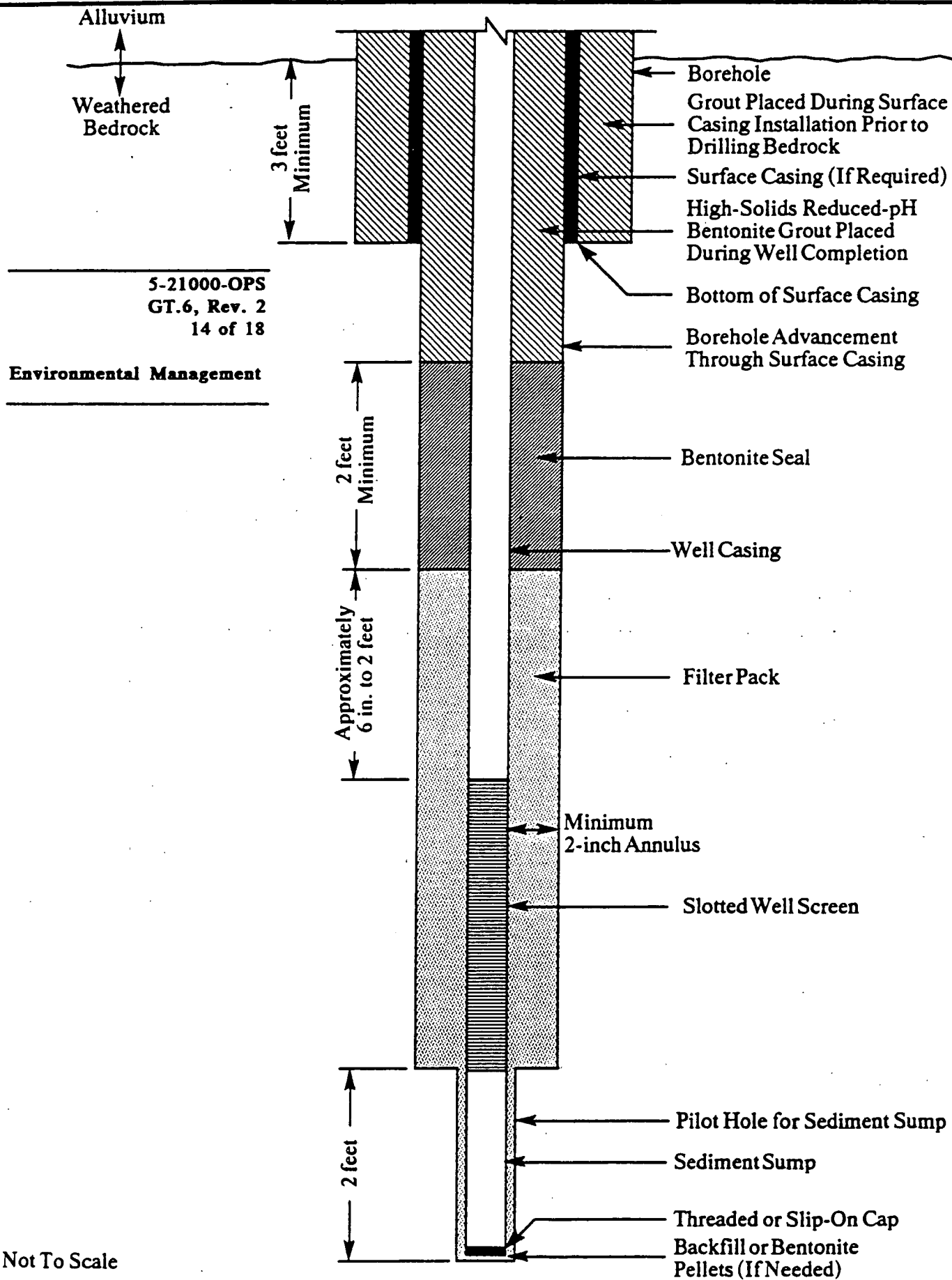
Figure GT.6-2 shows a schematic diagram of the lower portion of a bedrock well completion. Bedrock piezometers and monitoring well installations will be similar to the alluvial well installation procedures except that a surface casing may be provided through the alluvium to guard against potential cross-contamination of bedrock aquifers by contaminated alluvial groundwater. If required, the surface casing will extend from the ground surface to at least 3 feet below the alluvial/bedrock contact. This casing will be installed according to SOP GT.3, Isolating Bedrock from the Alluvium with Grouted Surface Casing.

If rotary drilling methods (see SOP GT.4, Rotary Drilling and Rock Coring) are required, the installation procedures will be similar except that the well may be completed in an open hole instead of inside of hollow-stem augers. The well string will be suspended approximately 2 inches above the bottom of the borehole prior to installing the filter pack. This will reduce bending of the well assembly and minimize the potential for collapse of the casing due to the weight of fluid in the annulus. Stainless steel centralizers will be placed at 20-foot-maximum spacing for wells completed in open holes.

Where wells cannot be completed in an open hole because of stability or other problems and/or the well cannot be completed within augers, the well may be installed through casing. This casing will be a diameter sufficient to provide a 2" annulus around the well casing and will consist of PVC or stainless steel. The casing will be advanced to the selected depth either using no additional fluids

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**FIGURE GT.6-2
SCHEMATIC DIAGRAM OF BEDROCK MONITORING WELL COMPLETION**



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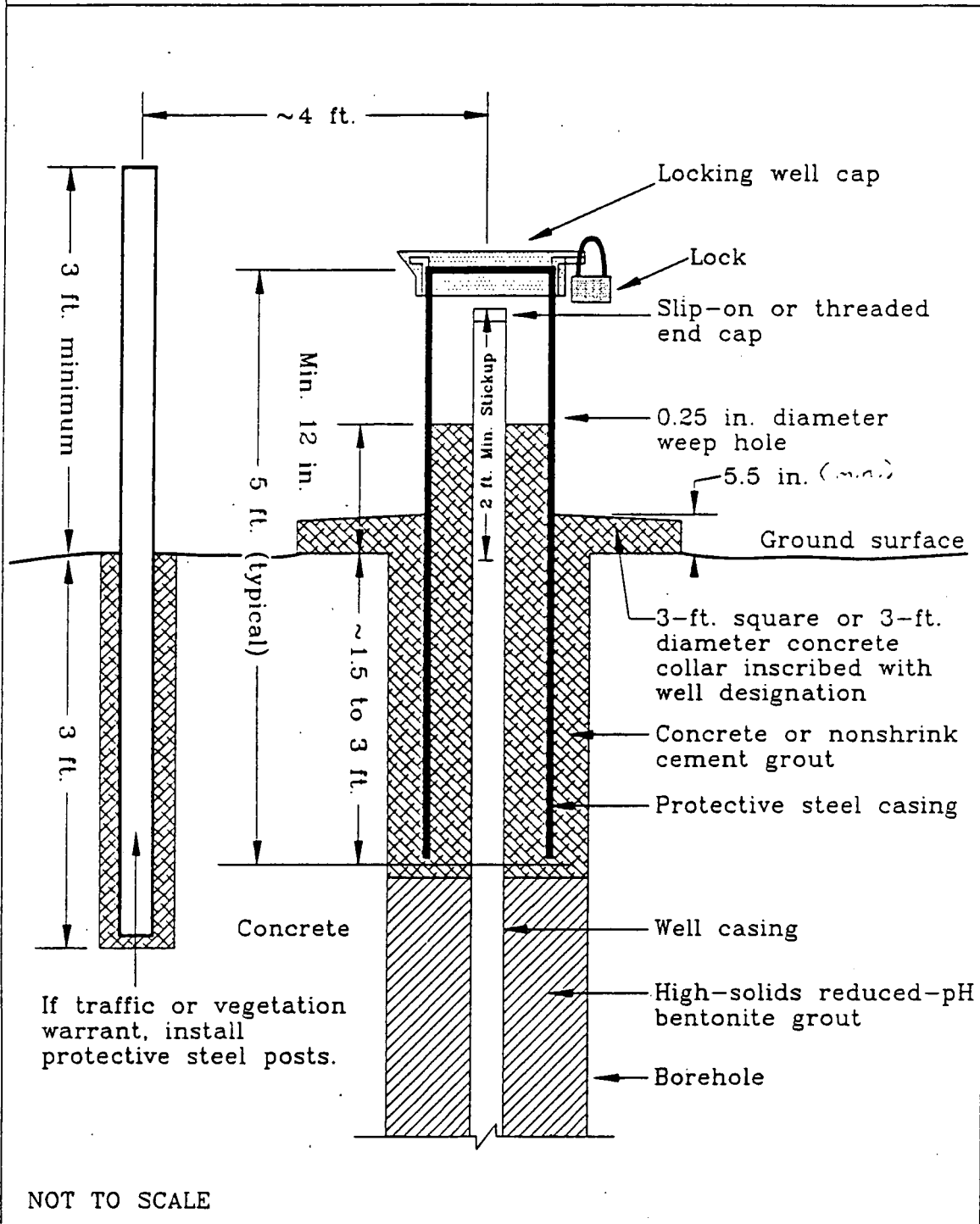
or by circulating RFP potable water down through the casing. After reaching the selected depth, a sand bailer will be used to remove any accumulated fluids until the borehole is bailed clear or until fluids are relatively clear and free of sediment. The well assembly will then be advanced through the casing to the designated depth and the annulus between the casing and the well assembly will be used to tremie well materials. The well will be installed as per the alluvial wells installed through augers except that the casing will be used instead of augers.

6.3.2.3 Well Features at Ground Surface

Figure GT.6-3 shows a schematic diagram of well features at the ground surface. A 5-foot-long protective steel casing with a hinged and locking steel cap will be installed over the monitoring well riser that projects above the ground surface between 24 and 72 hours after initial grout placement, except when temperatures are below freezing. A shorter length protective steel casing (no less than 3-foot long) may be used when shallow screens are required. The protective casing will have a minimum 8-inch I.D. for 4-inch wells and a minimum 6-inch I.D. for 2-inch wells. The well designation will be welded on the protective casing. The bottom of the protective casing will be embedded 2 to 3 feet below the ground surface in concrete or cement grout. Prior to installing the protective casing, the well will be checked for alignment by lowering a 5-foot long, 1 1/2-inch diameter bailer down the entire depth of the well. If the bailer hangs up, the EG&G project manager will decide whether or not the well needs to be reconstructed.

In landfill areas, both the inner casing and outer protective casing shall be extended by means of attaching blank casing (also known as a riser) such that the top of the outer protective casing shall be about three feet above the new ground level. The top of the riser shall have threads to allow for subsequent additions of new blank casing as landfill operations cause the ground level elevation to rise (see schematic diagram GT.6-4 of riser construction).

FIGURE GT.6-3 (9/23/93)
 SCHEMATIC DIAGRAM OF WELL FEATURE AT GROUND SURFACE



LOCKING CAP
WITH SET SCREWS

WEEP HOLE

SCH 40 PVC CASING

PVC COUPLE

STEEL PROTECTIVE
CASING

PORTLAND GROUT

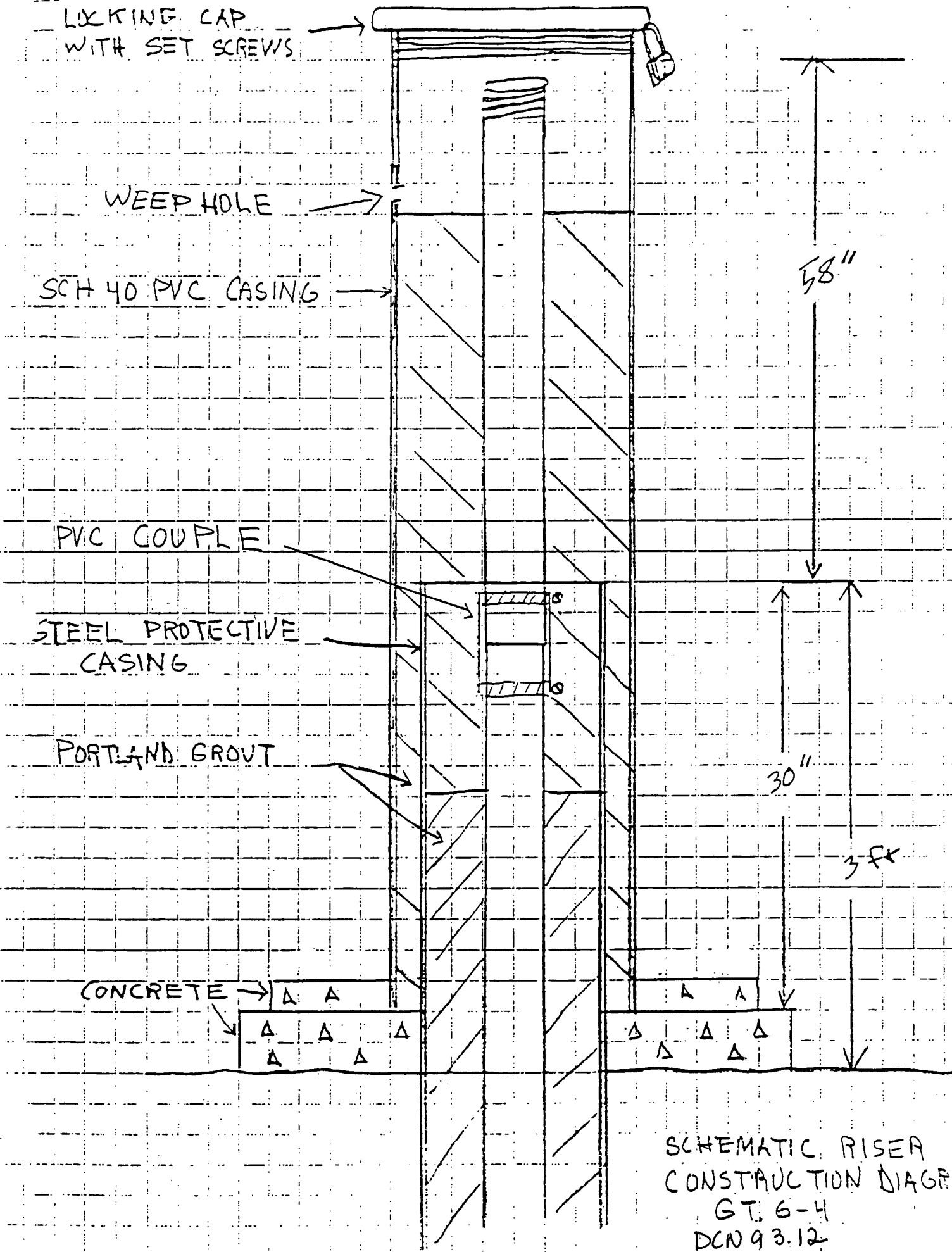
CONCRETE

58"

30"

3 ft

SCHEMATIC RISER
CONSTRUCTION DIAGRAM
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The annulus between the well riser and the steel protective casing will be filled with nonshrink cement grout or concrete to a minimum of 12 inches above the ground surface, and a 1/4-inch-diameter hole will be drilled in the protective casing just above the grout or concrete surface to allow drainage.

At the same time the protective steel casing is grouted or concreted in place, an external concrete collar approximately 3-foot square will be placed around the protective casing at the ground surface. The well designation will be inscribed in the concrete before it sets. The collar will be graded to slope away from the casing in all directions. The concrete collar will be 5.5 inches thick or greater.

When traffic conditions or vegetation warrant extra protection, four 3-inch-diameter steel posts will be installed. The posts will be located radially from the well casing at a distance of approximately 4 feet. They will be embedded in concrete 3 feet below the ground surface with a minimum of 3 feet sticking up above the ground. Installation is required within 72 hours of well installation. In areas of high vegetation, the posts will be flagged. Painted metal stakes shall be used to flag the location of the monitoring well or piezometer in high traffic areas. The stakes shall be installed in lieu of bumper posts.

When daytime temperatures are consistently below freezing, it is not feasible to excavate the upper most 1 1/2 to 3 feet of grout in order to install the surface well features since the grout is often frozen and difficult to remove. In addition, poured concrete may freeze before it cures causing cracking and necessitating replacement to ensure a surface seal. In these instances, the PVC well riser will be securely capped until warmer weather allows the setting of surface features. Wells installed during freezing weather will not be permitted to stand without surface features for more than two months.

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6.4 WELL POINT INSTALLATION

This Section describes the procedures used for installing well points. Before installation, sites will be located, numbered, and identified using stakes (or paint sticks on paved surfaces). Refer to SOP GT.10, Borehole Clearing, for more information regarding clearing the sites of underground obstructions.

After test sites have been located and cleared, an exclusion zone will be established according to the project Health and Safety Plan. The procedure for installing well points at a specific location is as follows:

1. Decontaminate the rig and downhole equipment. See SOP FO.3, General Equipment Decontamination for specific details regarding decontamination.
2. Set up the rig to obtain a thrust direction as close to vertical as possible.
3. Advance threaded expendable point by either hydraulically pushing or hammering to desired depth.
4. At locations within an IHSS, monitor the breathing zone near the rig for volatile organic compounds.
5. Insert the end of the hand-perforated tubing (Polyethylene or Teflon) with a threaded stud attached into the probe rods. Thread this into the expendable drive point. Length of perforated tubing will range between one and five feet based upon magnitude of anticipated water level fluctuations.
6. Hydraulically withdraw probe rods from hole.

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7. Place 10/20 silica sand filter pack to approximately six inches above the top of the screen while keeping tension on the tubing. Place at least six inches of granular bentonite seal above filter pack.

8. Install four-inch long, one-inch diameter PVC casing with threaded or slip cap as protective well-point surface casing. Protective casing will be nearly flush with the ground surface.

9. Install four-foot long, three-inch diameter steel post adjacent to protective casing to act as marker and traffic barrier. Post should be installed such that three feet are above ground.

10. Develop well point with peristaltic or inertia pump. Since these well points are only for measuring water levels, it is not necessary to measure all the parameters referenced in SOP GW.4, Well Development.

11. Survey top protection casing because well-point tubing is too flexible. Refer to SOP GT.17, Land Surveying, for more information regarding site surveying procedures.

DCN 93.02

7.0 DOCUMENTATION

Provide the WIN form to the Geosciences Division as instructed in 5.1.1. Submit copies of applicable (Sections 5.1.6 and 8.0) records related to this administrative procedure to Geosciences Division.

The installation of monitoring wells and piezometers will be documented on groundwater monitoring well and piezometer report forms. Drilling information will be documented on the Rocky Flats Plant Borehole Log form (Form GT.1A) and on the Hollow-Stem Auger Drilling form (Form GT.2A), or on the Rotary/Core Drilling form (Form GT.4A). Besides the drilling and

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borehole information required by these other SOPs, the following documentation will be recorded on the Groundwater Monitoring Well and Piezometer Report Form (Form GT.6A). Location references will use the State Plane Coordinate System and elevations will be in feet above mean sea level (USGS datum). All depth and height measurements will be from ground surface.

- Elevation of ground surface
- Height of top of protective casing
- Height of top of well casing
- Depth of protective casing
- Type and size of protective casing
- Depth of surface seal
- Type of surface seal
- Type and size of well casing
- Type/volume of backfill
- Depth of top of seal
- Type of seal
- Depth of top of filter pack/bottom of seal
- Type/volume of filter pack
- Depth of top of screened section
- Type and size of screened section
- Size of screen openings
- Depth of bottom of screened section
- Depth of bottom of filter pack
- Length of plugged blank section (sump) below screen
- Depth of bottom of plugged blank section (sump)
- Type of backfill below filter pack
- Diameter of borehole
- Depth of borehole

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- Type and depths of centralizers if used
- Generalized stratigraphy and water level summary (based on rig geologist notes)

8.0 ADMINISTRATIVE DOCUMENTATION

The two forms for documenting well completion data and well installation notification for wells (and piezometers) follow the section. The Well Installation Notification Form GT.6A is completed and submitted to the Geosciences Division. Field information documented on the Groundwater Monitoring Well and Piezometer Report Form GT.6B should be entered in electronic data format as specified in SOP FO.14, Field Data Management Form FO.14G. Upon completion of data entry and quality control check, Form GT.6B is delivered to the Operable Unit Project Manager.

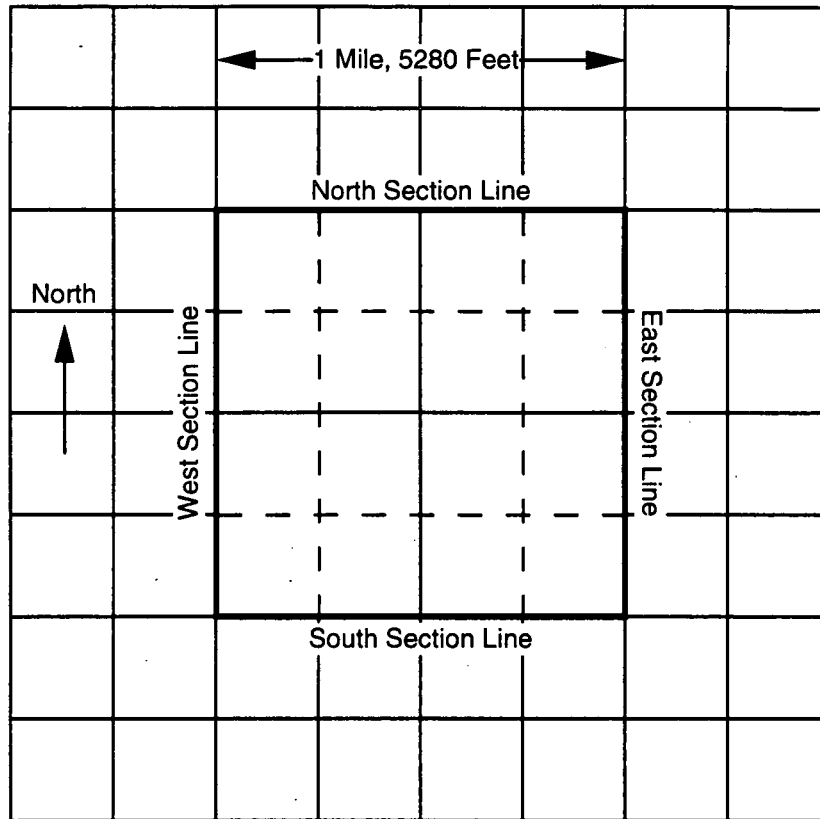
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Well Installation Notification Form

Project Name		Location Code (Well Number) (Geosciences Use Only)	
Requestor (Person/Organization)		Phone Number	Pager ID
Approximate Well Location (Show on Back) Approximate State Plane Coordinates _____ Northing, _____ Easting _____ 1/4, _____ 1/4, Section _____, T _____, R _____			
Land Owner <input type="checkbox"/> DOE <input type="checkbox"/> Other _____			
Type of Well Installation <input type="checkbox"/> Monitoring and Testing Only <input type="checkbox"/> Production/Recovery <input type="checkbox"/> Other _____			
Purpose of Well		Driller License Number	
Data Quality Objectives			
Expected Date of Well Completion	Projected Life of Well <input type="checkbox"/> < 1 Year <input type="checkbox"/> > 1 Year	Future Uses	
Target Aquifer <input type="checkbox"/> Surficial Deposits – Unconfined <input type="checkbox"/> Shallow Bedrock – Unconfined <input type="checkbox"/> Deep Bedrock – Confined (Requires Special License)			
Well Construction Details <input type="checkbox"/> Other (Describe) _____ <input type="checkbox"/> Per SOP _____			
Well Diameter (inches) (I.D.)	Casing Type	Screened Interval _____ to _____ ft.	
Annular Seal Type and Interval	Estimated Total Depth	Pump Installation <input type="checkbox"/> N/A <input type="checkbox"/> Type/H.P. _____	
Type of Well Installation <input type="checkbox"/> Hollow Stem Auger <input type="checkbox"/> Driven <input type="checkbox"/> Sonic <input type="checkbox"/> Fluid Rotary <input type="checkbox"/> Air Rotary <input type="checkbox"/> Other _____			
Environmental Protection Measures Taken During Drilling			
Requestor Signature		Date	Page ____ of ____
GEOSCIENCES USE ONLY			
Well Installation Requirement	<input type="checkbox"/> Notice	<input type="checkbox"/> Permit	
Pump Installation Requirement	<input type="checkbox"/> None	<input type="checkbox"/> Permit	
Drilling Contractor Requirement	<input type="checkbox"/> None <input type="checkbox"/> Special License	<input type="checkbox"/> Licensed	
Well Abandonment	<input type="checkbox"/> Notice <input type="checkbox"/> None		
Reviewer Signature		Date	

The Location of the Proposed Well

Use the CENTER SECTION (1 section, 640 acres) for the well location.



The scale of the diagram is 2 inches = 1 Mile
Each small square represents 40 acres.

Key:

- | | |
|---|--------------------------|
| Requestor's Well | <input type="radio"/> |
| Nearest RFP Well
and
RFP Well Number: | <input type="checkbox"/> |

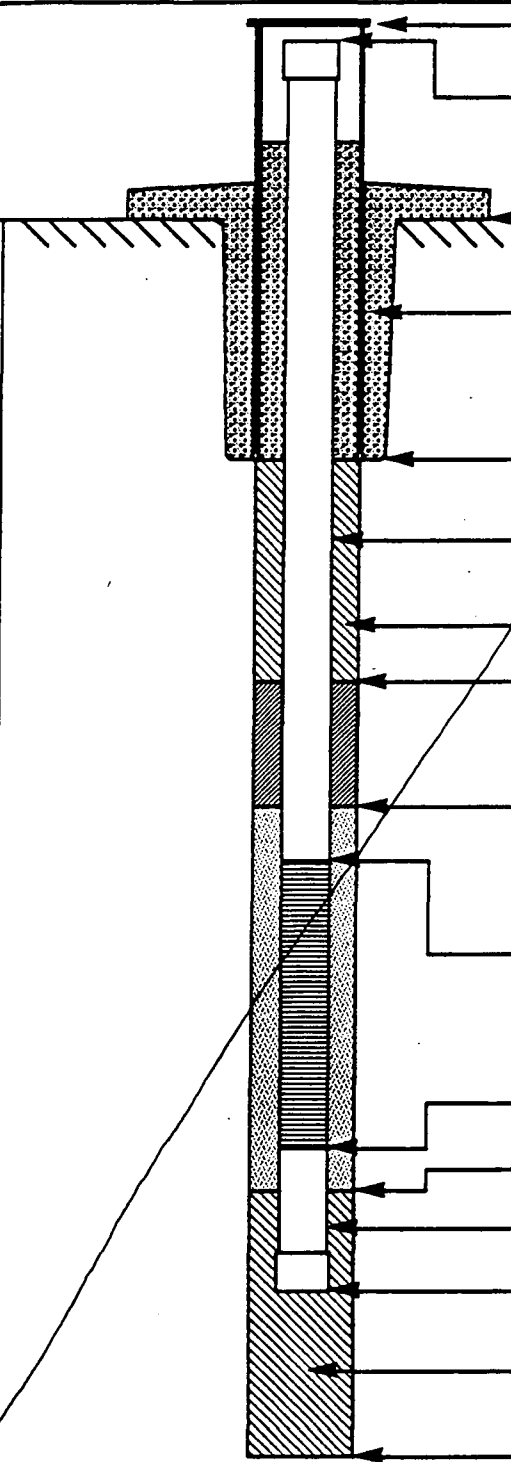
Groundwater Monitoring Well and Piezometer Report

PROJECT NAME _____		WELL NO. _____	
LOCATION _____		SCREENED INTERVAL _____	
DATE COMPLETED _____ TOTAL HOLE DEPTH (FT) _____		DEPTH (FT) _____ to _____	
CHECKED BY _____ DATE _____		LITHOLOGY _____	

NOTE: All measurements will be from ground surface. Centralizer depths (when applicable) will also be shown.

Surface Casing Used (Check 1): <input type="checkbox"/> Yes <input type="checkbox"/> No	
(If Yes, See Form GT.3A for specific information)	

Generalized Stratigraphy and Water Level Summary (Based on Rig Geologist Notes)



Height of top of protective casing (Ft) _____

Height of top of well casing (Ft) _____

Ground Elevation (Ft) _____

I.D. of protective casing (In) _____

Type of protective casing: 94-DMR-000

Depth of protective casing (Ft) _____

Depth of surface seal (Ft) _____

Type of surface seal: _____

I.D. of well casing (In) _____

Type of well casing: _____

Type of backfill: _____

Depth of top of seal (Ft) _____

Type of seal: _____

Depth of top of filter pack / bottom of seal (Ft) _____

Type of filter pack: _____

Depth of top of screened section (Ft) _____

Type of screened section: _____

I.D. of screened section (In) _____

Size of screen openings (In) _____

Depth of bottom of screened section (Ft) _____

Depth of bottom of filter pack (Ft) _____

Length of plugged blank section - Sump (Ft) _____

Depth of bottom of plugged blank section - Sump (Ft) _____

Type of backfill below filter pack: _____

Diameter of hole (In) _____

Depth of hole (Ft) _____

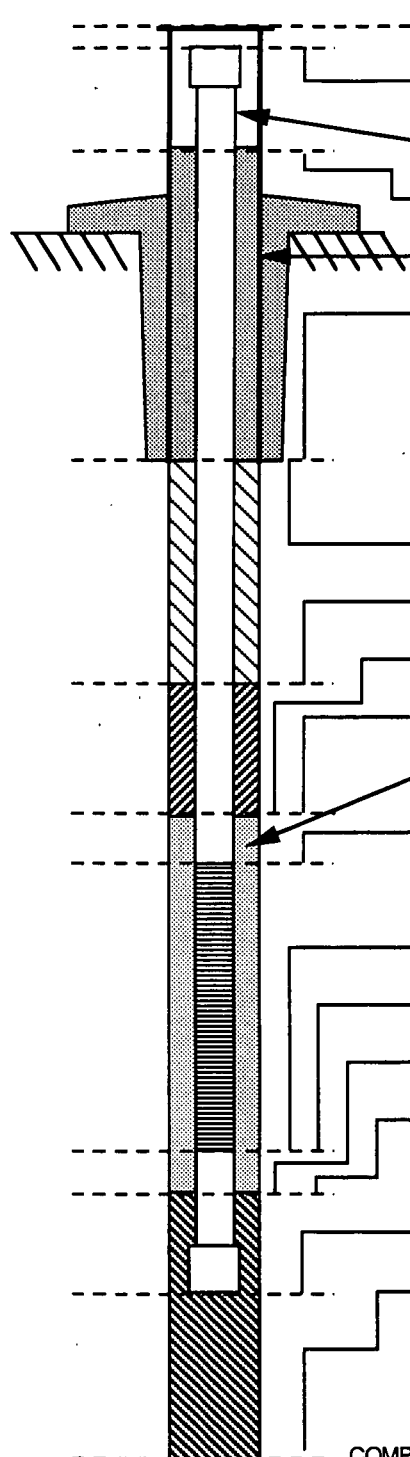
Replace with Form GT.6.B

94-DMR-000

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: _____ PROJECT NAME: _____ PROGRAM: _____
 SCREENED FORMATION: _____ DRILLING CONTRACTOR: _____
 DRILLING METHOD: _____ DATE DRILLED: _____ DATE COMPLETED: _____
 RIG GEOLOGIST: _____ LOGGING GEOLOGIST: _____
 COMPLETED DEPTH (FT): _____ ESTIMATED DEPTH TO BEDROCK (FT): _____
 BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): _____

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): _____ INITIAL WATER LEVEL (FT): _____ DATE MEASURED: _____
 COMPLETED WATER LEVEL (FT): _____ DATE MEASURED: _____



PROTECTIVE CASING, TOP (FT): _____ (FROM GROUND SURFACE)
 SURFACE CASING (STICKUP), TOP (FT): _____
 SURFACE CASING, I.D. (IN): _____ TYPE: _____
 SURFACE SEAL, TOP (FT): _____ TYPE: _____
 PROTECTIVE CASING, I.D. (IN): _____ TYPE: _____
 PROTECTIVE CASING, BOTTOM (FT): _____
 IF APPLICABLE SECONDARY CASING, TOP (FT): _____ BOTTOM (FT): _____
 SECONDARY CASING, I.D. (IN): _____ TYPE: _____
 CENTRALIZER, O.D. (IN): _____ TOP (FT): _____ BOTTOM (FT): _____
 GROUT SEAL, TOP (FT): _____ TYPE: _____
 BENTONITE SEAL, TOP (FT): _____ TYPE: _____
 BENTONITE SEAL, BOTTOM (FT): _____
 FILTER PACK, TOP (FT): _____
 FILTER PACK TYPE: _____ BRAND: _____
 SURFACE CASING, BOTTOM (FT): _____ SCREEN, TOP (FT): _____
 SCREEN SLOT SIZE (.000 IN): _____ SCREEN, I.D. (IN): _____
 SCREEN, BOTTOM (FT): _____ TYPE: _____ BRAND: _____
 SUMP, TOP (FT): _____ TYPE: _____
 FILTER PACK, BOTTOM (FT): _____
 BACKFILL, TOP (FT): _____ TYPE: _____
 BACKFILL, BOTTOM (FT): _____
 SUMP, BOTTOM (FT): _____
 TOTAL DEPTH (FT): _____
 REMARKS: _____

ALL MEASUREMENTS
WILL BE MADE FROM
GROUND SURFACE.

COMPLETED BY: _____ DATE: _____

CHECKED BY: _____ DATE: _____